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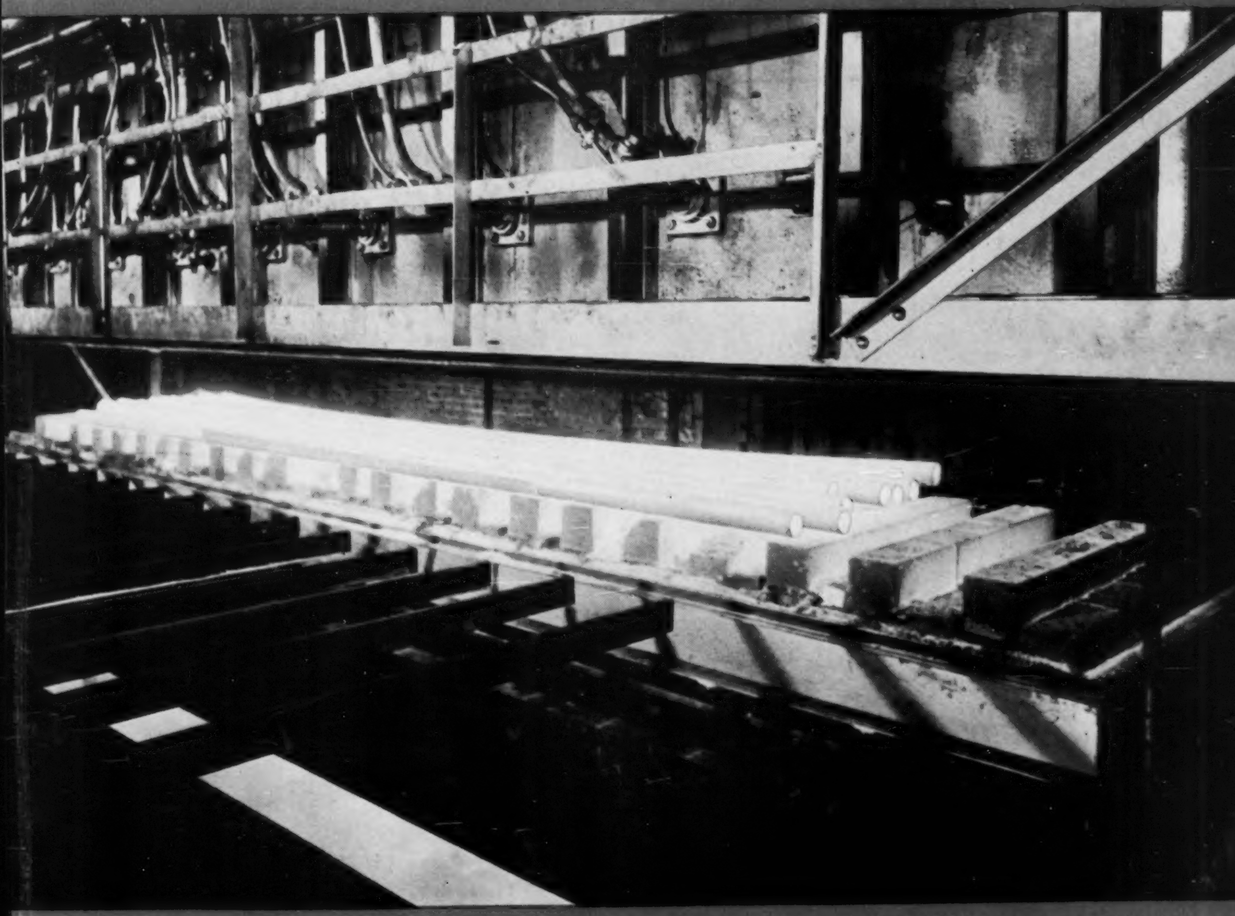
March-April 1956

METAL TREATING

MASTER CRAFTSMEN
METAL TREATING INSTITUTE

This furnace, shown heating stainless steel tubing, is used for a variety of heat treating operations—can handle 5000 lbs.—and provides temperatures from 250°-2275°F. (See page 2)



THE *Only* MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

MASTER CRAFTSMEN
METAL TREATING INSTITUTE

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Indexed in Engineering Index

EDITORIAL

Heat Treaters Properly Recognized in Critical Occupation List

The Department of Labor has recently issued a "List of Critical Occupations for Screening the Ready Reserve". The list is now compiled that will go into effect immediately upon the declaration of a national emergency. All occupations listed will be automatically critical and the activity will become an essential one. Quite properly, "HEAT TREATERS—ALL ROUND" are included in this list. The occupation is defined as follows:

"Alters the physical properties of metal and alloy objects of a wide variety and of diverse shapes and sizes by controlled heating and cooling to produce specified degrees of hardness, strength, and toughness: Plans own work sequences and exercises considerable judgment in the application of heat treating methods and techniques where a high degree of control is necessary to obtain desired physical characteristics. Applies knowledge of practical metallurgy and of the characteristics of furnaces, chemical baths, mechanical and electrical control as hardening, tempering, annealing, normalizing, carburizing or cementation, case hardening, cyaniding, and nitriding. Specifically excluded from this classification are those workers who follow specified heat-treating procedures and whose duties are usually limited to feeding identical units into a furnace and maintaining temperatures within prescribed limits and to objects of a limited variety."

Copies of the booklet containing the list and definitions of the occupations may be secured from the Department of Labor.

C. E. Herington

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A COMMERCIAL HEAT TREATING FURNACE INSTALLATION

By **JOHN P. BENEDICT**
Benedict-Miller, Inc.
Lyndhurst, N. J.

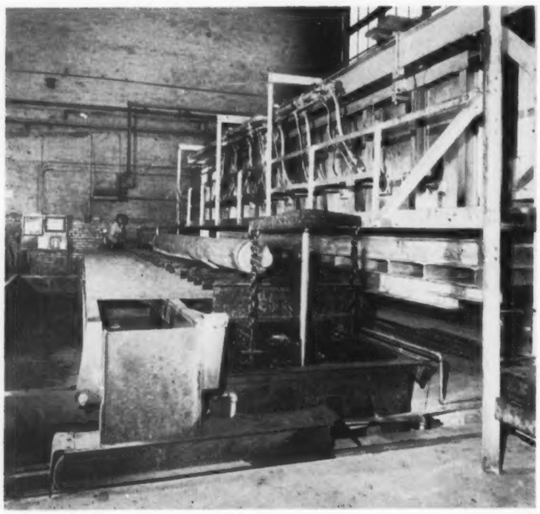


Fig. 1—A fabricated roll being put in position for loading on the loading rack by means of quench rack.

Fig. 2—Pieces of 1¾" X 20' alloy about to be loaded. Note the flame characteristics of the burner and the small area to be treated.

TO ATTEMPT to be successful in his line of business, a commercial heat treater must handle both large and small items and long and short production runs efficiently and economically. To do this, each piece of furnace equipment must be capable of doing a number of different jobs with a minimum amount of labor in a minimum number of hours. Benedict-Miller, Inc., Lyndhurst, N. J., added such a furnace to their steel warehousing and heat treating facilities several years ago.

This unusual bottom-opening type of furnace was originally installed to handle the heat treating of bars and tubing according to the large number of different heat treated conditions that are being specified by buyers and engineers today. Capable of handling a 5,000 pound load (See Fig. 1), it has operated at all temperatures ranging from 250° F. to 2275° F., and has handled everything from Hastelloy bars to Teflon tubing. It has a hearth which is 55" wide and 27' long, and handles material up to 10" in diameter. Operations such as stress relieving, tempering, annealing, spheroidizing and normalizing are performed through this wide temperature range with a variation of only plus or minus 15° F., which is well within the Air Force and government heat treating specifications of plus or minus 20° F.

Sixteen nozzle-type burners, eight on each side of the furnace and each with individual pilots, fire 12 inches above the hearth bed. The air and gas are proportioned respectively by 4-inch and 3-inch adjustable port valves and pass through separate lines to the nozzle of the burner where the mixing takes place. In this way a long, bushy, luminous flame is produced as is seen in Fig. 2, with an accompanying high rate of heat transfer to the material being heat treated. 1600 cu. ft./hr. of air at 0.5 inches water column and 350 cu. ft./hr. of gas at 6.0 inches water column are supplied to each burner. A turn down ratio of higher than 8 to 1 can be obtained. The hearth of the furnace is divided into six zones with a printed temperature being recorded for each zone every 90 seconds by a Foxboro 6-point electronic recorder. The proportioning valves are controlled by a Brown Controller which both indicates and records the temperature of the Master Control point. A Micromax electrical control unit with automatic droop correction is used in connection with the Brown Controller to get the proper proportioning action in correct relation to the weight of the load being run.

Only one man is needed to load and unload this furnace. Work to be heat treated is first placed by crane on the forked transfer rack which is then hydraulically fed into the furnace. (Fig. 3.) The hearth is raised hydraulically and lifts the charge off the transfer rack, and the latter is withdrawn from the area. The hearth is then completely raised until the

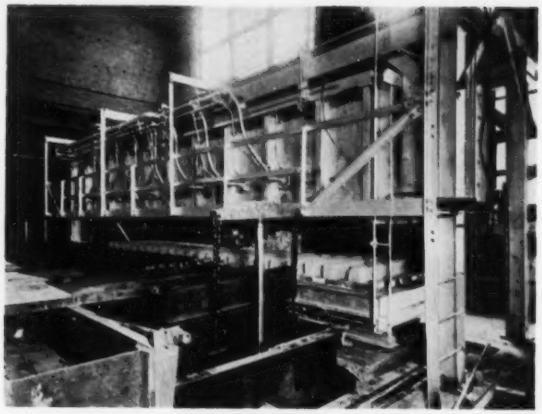


Fig. 3—Quench rack about to drop the bars on the unloading rack.

furnace and its sand seal fit snugly together. The actual heat treating cycle is now ready to begin.

While in the furnace, the bars rest on highly conductive refractory piers with a space of seven inches between piers. This design affords even support of the charge without attendant sagging and fast uniform heating rates. The closely spaced forks on the transfer rack offer the same advantage while the material is being transferred into the quench.

When quenching is required after the heater material is removed from the furnace by the transfer rack, it is quenched into an oil-filled tank 28′ long by 6′ wide by 6′ deep which is adjacent to the furnace. The quench rack is raised hydraulically and lifts the charge from the transfer rack, the rack is retracted, and the quench rack with the charge is immersed in the oil bath. (See Fig. 4). The time cycle involved in removing the charge from the furnace and submerging it in the quench tanks varies between 1½ minutes to 3 minutes, depending on the type of load being quenched . The operations are simple and rapid. Because the entire charge is uniformly quenched at one time there is no difference in quench temperature, and therefore minimum variance occurs in the physical properties of the bars.

The hydraulic loading and unloading mechanism means that the furnace can be loaded or unloaded at any temperature. No time is lost, as is sometimes the case in a car-type furnace, for a car to come down to working temperature before a man can get up on the car to block up the load. This important feature results in the performance of more diversified operations in a shorter period of time. It also makes much simpler the loading of forged rings, die blocks or plates which are also heat treated out of this unit. They can be laid out by crane on the transfer rack and loaded into the furnace just the way they are laid out. No time is consumed pushing and shoving as is the case when they are loaded into or quenched from a box furnace, and there is no heat to contend with as when they are loaded onto or quenched from a car-type furnace. Also, because of the minimum amount of space that has to be heated and as a result of the bottom-opening characteristic of the furnace, it can be brought up to heat rapidly and cooled very rapidly, thus giving quick access to any one of its wide range of temperatures. The temperature uniformity is good in all of its operating temperature ranges, so it is also used as a draw furnace on many hardening operations, particularly in bar work. Stress relieving is also done in this unit on bars after straightening, and rounds up to 1½″ and flats up to 1″ x 4″ are straightened. By the use of certain types of fixtures, parts of any size can be handled if the quantities are large enough. ■ ■ ■

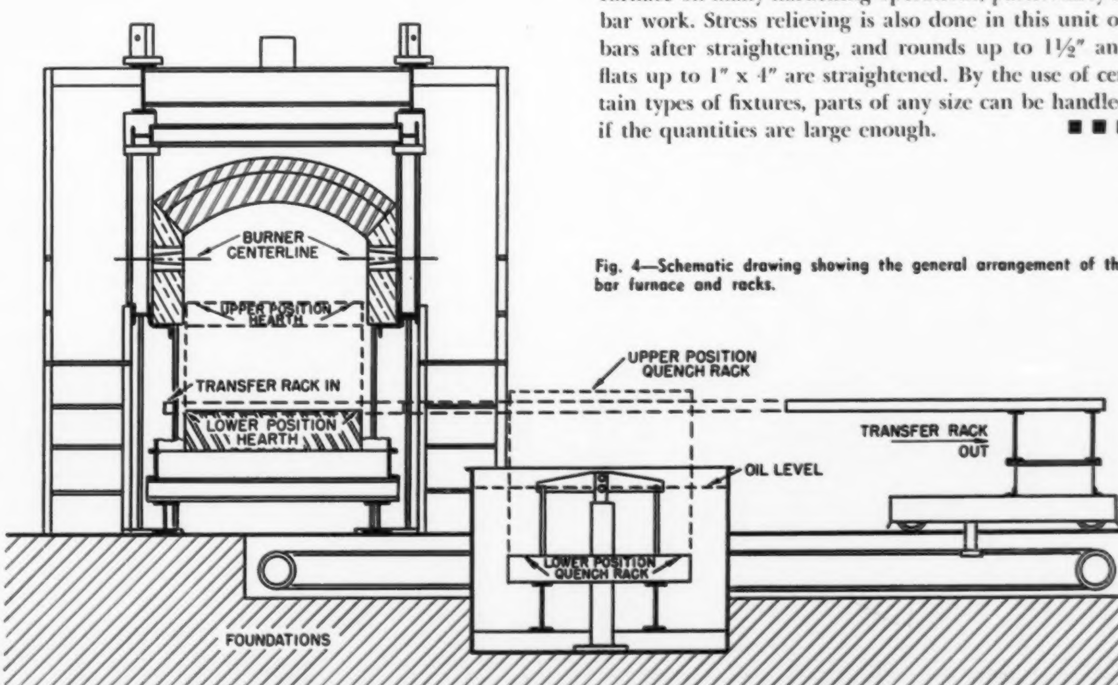


Fig. 4—Schematic drawing showing the general arrangement of the bar furnace and racks.

CONTROLLED ATMOSPHERE HEAT TREATING AND EQUIPMENT

Editor's Note: *It was felt that to reduce this article in length to fit one issue would be to sacrifice its value, hence this is Part I of two parts.*

By **F. E. HARRIS**
The Dow Furnace Co.
Detroit, Michigan

CONTROLLED atmosphere heat treating involves the regulation of surface chemistry of the charge by application of prepared gases during preheating, heating and cooling cycles. Operational procedures are concerned with numerous factors and a step by step evaluation of a cycle with reference to typical constructions may be instructive. Before we begin a more or less detailed analysis of the problems of controlled atmosphere processing however, let us first consider two of the basic conditions influencing these procedures.

First, the heat treating furnace itself is enveloped by an atmosphere,—air—, which is "foreign" or undesirable with respect to the controlled atmosphere. The barometric pressure of the surrounding air supports a column of mercury of some 30" high against a vacuum (or zero pressure on an absolute scale). Since water columns are a more convenient form of measurement, we find that atmospheric pressure translates into a column of over 400 inches of water. However, commercial furnaces in general operate at pressures only slightly above or below the 400 inches compressed by the air bath, and therefore, the furnace pressure is essentially one atmosphere. Establishing a base line pressure of one atmosphere, small changes in furnace pressure will be expressed by the symbol Δ P. The unit of measurement, inches of water, may be plus or minus, and its value at any point in the furnace has a profound influence on flow characteristics.

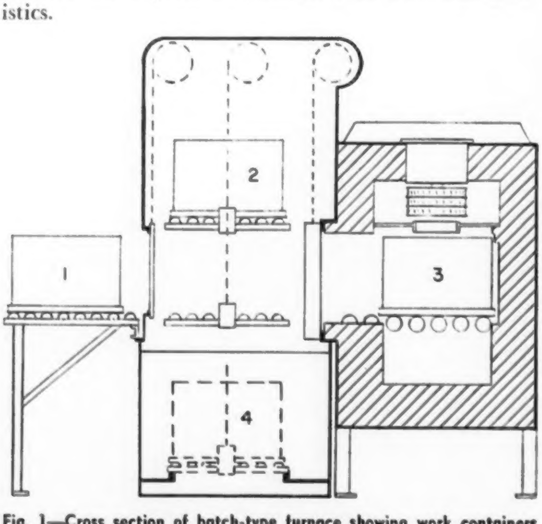


Fig. 1—Cross section of batch-type furnace showing work containers in their proper positions just prior to quenching.

The second condition concerns the wide range of temperatures involved in the preheating, heating and cooling cycles. When doors are opened or closed and transfers of the charge are taking place, the contraction or expansion of gases in the enclosed structure due to these temperature differences will cause fast changes in Δ P. The importance of these changes will be obvious as we apply control principles to the flow problems.

Returning to specific cycles and step by step analyses, divisions may be made with respect to container positions for the physical structure, Fig. 1. These positions may be evaluated with relation to processing factors in a continuous order as follows:

Position 1. The loaded container, prior to charging.

Position 2. The green load in the vestibule.

Position 3. The container and load as heated.

Position 4. The container and load as quenched.

The Loaded Container, Prior to Charging, Position 1

The manner in which a receptacle is loaded, Position 1, is prescribed by a number of factors where the metallurgical requirements must be matched by construction features, gas application, heating and quenching facilities, handling provisions, and to a great degree by the dimensional characteristics of the parts being processed. Symmetrical loading has obvious advantages when we consider heat transfer phenomena and gas application to surface areas; such loadings for symmetry may vary from random loading for certain types of parts to a definite fixturing for pieces where distortion control is a problem. The processor finds that each part and treatment has an optimum method, but a useful criterion for a charge as loaded is one of load density. This term is the per cent of weight per unit of container volume, where 100 per cent represents a completely occupied volume. Thus, a solid piece of steel with a volume of 4 cubic feet weighs 1,920 pounds; if a container with a volume of 4 cubic feet is loaded uniformly to the top with parts weighing 384 pounds, the load density becomes

$$\frac{384 \times 100}{1920} \text{ or } 20\%$$

High load densities are desirable for economic reasons, other things being equal, particularly when the time at temperature is long to meet deep case depth

requirements. However, the exposed area of the part with reference to its weight often suggests the optimum loading, and the specific part and the specific process must be viewed for their relation to loading factors. In general, when load densities rise above 30 per cent, special precautions are usually required, especially when the parts are small.

The Green Load in the Vestibule, Position 2

The hot gases flowing from the heating chamber to the vestibule, which is the direction of gas flow, perform a beneficial action in drying the green charge to remove traces of water or oil contamination from the container and parts. The vestibule itself plays an important role in the processing operation in that it affords an opportunity for protection of both the heating chamber and the quenching bath. The gas composition in the vestibule during transfers to and from the heating chamber is that of the heating chamber itself and in this connection it may be termed an atmosphere lock.

To prevent air contamination, a liberal value for Δ P can be evaluated, and from this value the formulation for carrier gas flow rates is determined. The evaluation for Δ P is based on the extremely low specific gravity of the hot gases in the chamber compared with that of the air enveloping the furnace; often this specific gravity (a function of gas composition and temperature), will not exceed one-tenth of that of the enveloping air which is at normal or room temperature. Assuming that the column weight of this hot chamber gas is negligible, a comparison of the densities of air and water shows that a 70 foot air column has the weight of one inch water column. Since Δ P is to be expressed in inches of water, and since a seven foot vertical height of the heated section amply covers all except very large atmosphere units, the safe and minimum figure for Δ P is readily obtained, namely $\frac{7}{70}$, or one-tenth inches of water column. If we treat the openings found in the entire outside surface area of the heat treating unit as a single orifice, then with the enveloping air at atmospheric pressure and the gas in the unit above atmospheric, we may apply the flow rate formula for the orifice,

$$Q = KA\sqrt{\Delta P}$$

where Q is the flow rate, A is the area of the openings connecting the unit and the enveloping air, and K is a proportionality factor whose value depends on the units expressing the flow rates, area and pressure drop. For our purpose we may express Q in cubic feet per hour of carrier gas at room temperature as it is supplied to the hot chamber and A, the area of the openings in square inches. When Δ P is 0.1 inches of water, taken as a minimum safe pressure, we may write

$$\frac{Q}{A} = 300$$

or translating this to an operation rule, we must supply 300 cubic feet per hour of carrier gas for every square inch of opening in the outside casing to prevent air infiltration and subsequent atmosphere contamination. The first rule of controlled atmosphere construction is a tight outer casing.

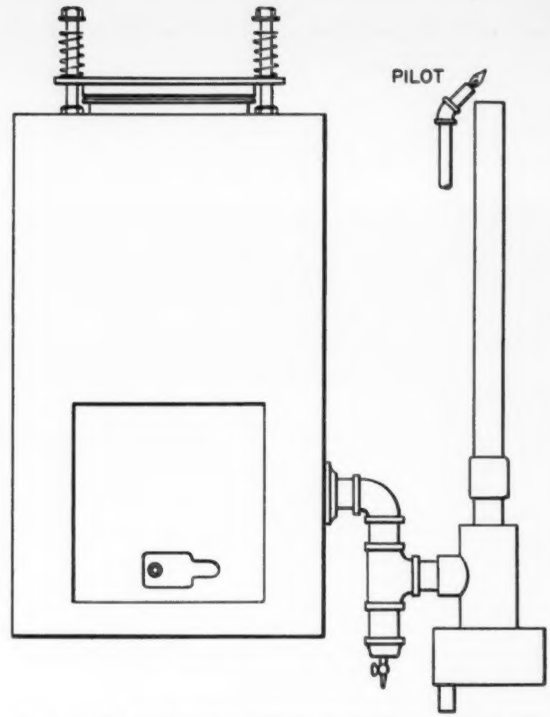


Fig. 2—Front view of furnace vestibule showing the outer door, outer door slide port, pressure relief valve, and explosion head.

The vestibule is provided with pressure control and purging devices to correct air contaminations on initial charging and discharging, and to minimize what might otherwise be rapid changes in Δ P. The breathing phenomena, due to sudden expansion or contraction of gaseous volumes occur only during the transfer operations, and these phenomena will be explained in detail later in the discussion.

In general, all of the gas supply is made to the heating chamber, and with the inner door closed, the flow is through a small port in the inner door to the vestibule. The vestibule is equipped with a constant pressure control, Fig. 2, attached to one side by a 2½" pipe, and with a 2½" effluent pipe for a discharge through a seal of flowing water. The effluent pipe, Fig. 3, extends downward into the water a very short distance, 0.1" in fact, a figure we developed for Δ P. When the gas pressure is greater than this value of 0.1 inches of water (the carrier gas supply rate is sufficient to exceed this pressure when the unit is in the normal or sealed state), the water seal is depressed and the gas flows out through the vertical discharge pipe where it is lighted by a gas pilot.

The outer door of the vestibule operates inside of the vestibule, and there is a particular reason for this

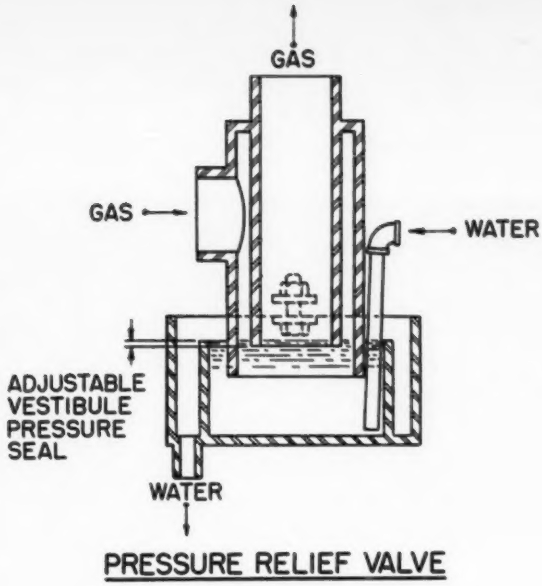


Fig. 3—Pressure relief valve details.

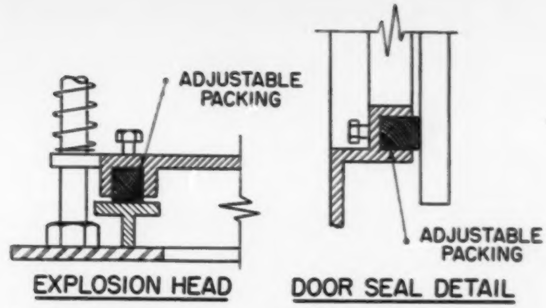


Fig. 4—Method of installing adjustable packing for sealing outer door, and explosion head.

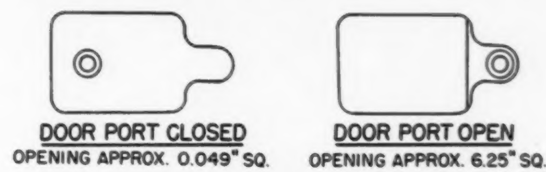


Fig. 5—Outer door slide port details.

construction. While all other portions of the outside casing may be welded or gasketed to form a gas tight construction, with the door which must open and close, and with its large area, tight sealing is a problem. This outer door seals against a packing ring which is adjustable at any spot of poor seal by means of adjusting screws in the outer casing, Fig. 4. Furthermore, should any leak occur, the gas burns across the plate, rather than around the edge, reducing the possibility of door distortion. It will be appreciated that the bypassing of gas through the relief (above a minimum pressure) also aids in solving the door sealing problem.

The outer door is equipped with an opening covered with a heavy slide which operates in restraining ways mounted on the inside surface of the door, Fig. 5. In the closed or normal position, a ½" pipe, orificed to ¼" diameter, allows a small gas flow, ignited by a gas pilot. In the open position, an area of six square inches (2" wide by 3" long) is opened in the outer door. This opening is in line with the horizontal rolls carrying the container.

The Container and Load as Heated, Position 3

In the high temperature zone, the problems of heat supply are connected with those of the atmosphere application and our concern is with the correlation of pertinent factors. The primary concern for atmospheres is related to gas flow rates as they are applied to the hot chamber and to the composition of the gaseous mixtures.

From the supply viewpoint, the atmosphere may be termed as a carrier or prepared gas plus additives. For most applications, the function of the carrier gas is the protection of carbon potential; additives such as natural gas and ammonia are employed for carbon and nitrogen additions to the charge. By this natural division of the gas components, the flow rate of carrier gas is dictated by the requirements of atmosphere protection, while the flow of additives is a function of the metallurgical requirements of the process.

We may deal with the carrier gas composition by evaluating a few pertinent reactions, and at the same time develop a method of evaluating the effect of air contamination. A common method of preparing carrier gases consists in passing mixtures of natural gas and air through a heated tube containing a nickel catalyst, and the products of the reaction in the tube depend upon the air/gas ratio and the temperature attained in the tube. To illustrate the phenomena involved, we assume that methane is the only component of natural gas and that the reactions go to completion as written. Let us consider two limiting ratios,

1. $CH_4 + 0.5\,(O_2 + 3.76\,N_2) = CO + 2\,H_2 + 1.88\,N_2$
2. $CH_4 + 2.0\,(O_2\ 3.76\,N_2) = CO_2 + 2\,H_2O + 7.52\,N_2$

where (1) represents the minimum air/gas ratio without excess methane and (2) represents the maximum air/gas ratio without excess air. These ratios are 2.38 and 9.52 respectively, since $O_2 + 3.76\,N_2$ represents air or 21% O_2 and 79% N_2. Note that the total volume of the products for either reaction is identical except for the nitrogen which does not enter into the reaction. For intermediate air/gas ratios, all four constituents will be found in the products, and the actual amounts for any given ratio is determined by the water gas reaction,

3. $H_2 + CO_2 = H_2O + CO$

which is very active at 1500°F. and above. From mass law considerations the actual composition as a function of temperature can be expressed by

4. $$\frac{\%\ H_2O \times \%\ CO}{\%\ H_2 \times \%\ CO_2} = K_1$$

(Continued on page 31)

X-RAY DIFFRACTION HELPS CONTROL QUALITY

By VERN W. PALEN
North American Philips Company, Inc. Mount Vernon, N. Y.

Ward Leonard laboratory experts discuss test results on a problem by checking peaks on an X-ray Diffractometer chart. (Left to right) George M. Galik, Chemical Division Head; Charles J. Ganci, Chemical Engineer and Manager of Manufacturing Engineering; E. H. Hilbert, Supervisor of Chemical and Ceramic Laboratories.

WET chemistry, petrographic microscopy and other analytical methods have largely been replaced by X-ray diffraction in solving research and quality control problems on metal and ceramic materials at the Ward Leonard plant in Mount Vernon, N. Y.

With these new X-ray tools it has been possible to keep abreast of an ever-increasing flow of technical analysis tasks and more important, to achieve exceptionally high standards in the characteristics of resistors, rheostats, relays and many other electrical products.

Flat contact arms on ring rheostats are made of SAE 1075 steel and sometime ago trouble developed on a certain lot during life tests. The metal cracked and appeared excessively brittle. The same thing happened to a batch of phospor bronze contact fingers used on relays.

X-ray diffractometer charts were made in each of these instances in order that the fautly metal could be compared with other lots having good performance records. Improper heat treatment was suspected so the laboratory put 15 or 20 specimens of the good metal through different annealing procedures.

The X-ray charts from the treated specimens established a definite clue. As heat treatment temperatures were raised and stresses in the metal decreased, chart peaks became proportionately narrower at their bases.

In other words, for speciments of the same basic composition, chart peaks with wide bases indicate more stress in the metal. The production lot of brittle contact arms and the batch of faulty contact fingers produced X-ray charts which exhibited this wide-base characteristic.

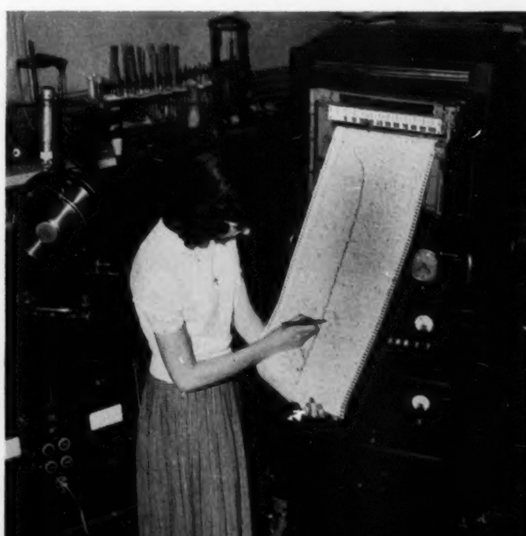
Another example where X-ray helped solve a problem was concerned with core material intended for use in a new magnetic amplifier. For best operating characteristics, it was important to have proper crystal orientation.

Hysteresis losses were excessive in some specimens of the core metal yet chemical tests gave no indication of what was wrong. When the laboratory studied grain size and orientation with the aid of a flat-plate X-ray camera the difference in core specimens was revealed. The supplier was then required to furnish the desired grain orientation.

Crystal structure of wire used for winding resistors is also highly important. Since electrical resistance directly reflects the degree of contact between crystal faces, it becomes vitally important to keep this factor under proper control. X-ray is helping the laboratory on this task.

Company specifications for some types of resistance wire require heat treatment to produce a preferential type of oxide coating which serves as insulation between turns on the finished product. Here again, X-ray analysis serves as a control to keep the oxide coating within the desired tolerance limits.

In general, X-ray techniques have made it possible for Ward Leonard to establish an entirely new set of standards for metal composition. ■ ■ ■



A laboratory technician examines chart during analysis of a specimen in the Norelco X-ray instrument.

NONDESTRUCTIVE SAMPLE TESTING FOR CRACKS AIDS HEAT TREATING

By **FRANKLIN S. CATLIN**
Magnaflux Corporation
Chicago, Illinois

IN CURRENT years, nondestructive testing methods such as Magnaflux and Zyglo have moved from final inspeciton to become a money-saving tool in production. They are used by production men. In this use, sampling inspection of pilot runs and during production runs checks the quality of both the material being used and the heat treating processes themselves so that defective parts are not made. This is more economical than finding defects and finished products. Used for control of heat treating, Magnaflux and Zyglo find useful applications in three locations, depending on the nature of the process.

Control of Material Entering Heat Treat

Incoming stock is widely inspected prior to heat treat, and often as bar stock forgings, castings, etc., prior to the machining operations which precede heat treating.

In the case of parts made from bar stock, the inspection finds the heavy non-metallic inclusions or segregates which would open up in heat treat to make serious cracks. Note Fig. 1 where Magnaflux inspection of a finished wrist pin shows a heavy non-metallic opened in heat treat to destroy the part. This could have been detected just as readily by inspection in the rough state to avoid this wasted machining, heat treating, and grinding. Likewise on forgings there can be flash line tears which become more pronounced after heat treat.

When steel or malleable castings are heat treated, invisible cracks present before the heat treat open up to make serious cracks that cause rejection after heat treat. Steel castings can have cracks which should be completely removed and areas repaired by welding prior to heat treat. Many malleable foundries are doing a quick Magnaglo inspection in the "hard iron" state to avoid putting cracked castings through the anneal. This serves to lower costs and increases the heat treating capacity by annealing only parts that will be useable. See Fig. 2 for cracks due to improper spruing in a malleable casting as detected with Magnaglo in the "hard iron" state.

Establishing Correct Heat Treat During Set-up

These test methods which find cracks quickly are used along with hardness tests in many plants, whenever a new lot of parts is started through heat treat. Thus the heat treat operation is set up so as to get the right hardness in the parts but without causing cracking that would otherwise continue throughout the heat treat run. For this use, a small Magnaglo unit is usually located right in the heat treat depart-

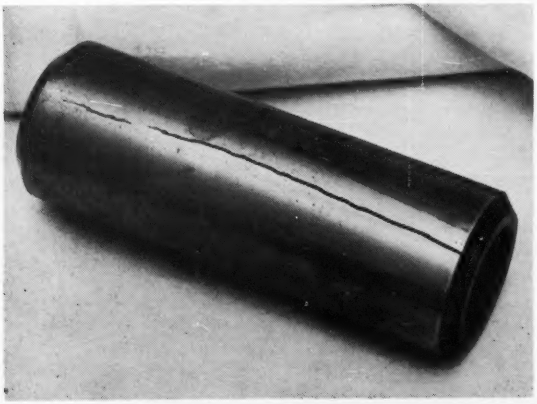


Fig. 1—Magnaflux inspection of finished wrist pin shows large crack which opened in heat treat, due to a non-metallic inclusion. The wasted finished machining and heat treating here, could have been saved if the inclusion had been detected by inspection before heat treat.

Fig. 2—Cracks shown with Magnaglo in malleable casting. Here they are detected in the "hard iron" state and annealing will not be wasted on this already cracked part. However, these cracks are due to improper spruing, which can be immediately corrected to avoid cracking more parts.

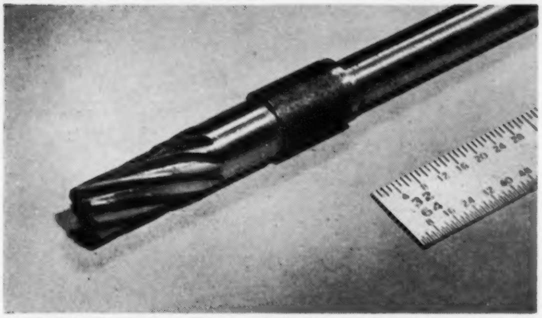


Fig. 3—Visual appearance of a shaft for an electric hand drill, as it looks when the first of a lot of these shafts are induction heat treated, during set-up.

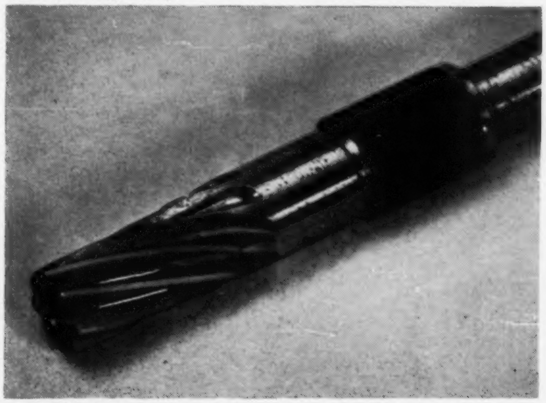


Fig. 4—During set-up, each of the first shafts heat treated is tested with Magnaglo, which here shows cracks that are eliminated in the heat treating of other shafts by correcting the time cycles of the automatic induction heat treater.

ment, and used by the heat treat foreman or supervisor.

Automatic induction heat treat operations are an example of the use of this inspection during set-up. In Fig. 3 we see the visual appearance of a shaft for an electric hand drill under white light, apparently uncracked. Fig. 4 shows cracks in the hardened teeth of the same part under black light after processing with Magnaglo. These cracks were found during set-up of the induction hardening. Procedures were immediately corrected so that there were no cracks in a run of several hundred of these shafts. These samples are from a company making many quality hand tools, and all of their induction heat treat set-ups are for a few hundred parts of many types and sizes. To avoid cracking parts during the heat treat, each set-up is checked with Magnaglo, and for hardness.

As another example, in one of the large farm tractor plants the induction heat treat man has a small Magnaglo unit in the automatic heat treat department. As he sets up the automatic cycles on the heat treat equipment, he checks for correct set-up in heat treating a wide variety of gears. Here, they have found that one of their biggest variables from job to job is in the temperature of the water quench. Sampling checks with Magnaglo are made regularly to be sure the cycles are correct and thus the quench is kept satisfactory.

Production Runs Controlled by Sampling

With Magnaglo or Zyglo in the heat treat department (depending on whether parts are magnetic or non-magnetic) the production men usually check a few sample parts out of each hour's run during any continuous or long production heat treat runs. Thus, if any of the variables in the heat treat process have changed to cause cracking of parts, the cause is found immediately and the heat treat process can be corrected to eliminate cracking. Similar checks can be made on batch type processes. Fig. 5 shows quench cracks pinpointed by Magnaglo after heat treat of steel castings. This shows that procedures are "going bad" and correction must be made immediately to confine this trouble to only a few parts.

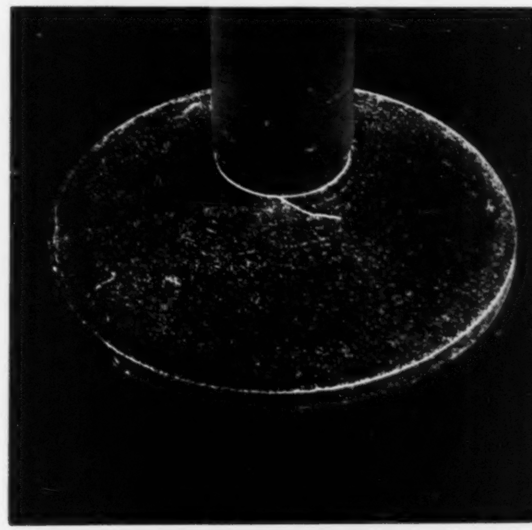


Fig. 5—Magnaglo pinpoints quench cracks in samples of steel castings, tested as they come from heat treat. Immediate correction of heat treat procedures will eliminate these cracks in future castings.

Find Design Problems Causing Heat Treat Cracks

Cracks that occur in heat treat are often due to sharp corners or other design characteristics. These sharp changes in section are sometimes not essential to the function of the part, but make it extremely difficult to heat treat without cracking. In such cases, a simple design change can greately reduce heat treat loss. Also, it can often permit use of a lower cost steel, without having to select high priced steels that are less touchy during heat treat. Fig. 6 is one of many examples of a part where Magnaglo shows a crack at a sharp corner in a change of section, where a round fillet could have reduced the possibility of cracking in heat treating. Sometimes, too, sharp corners are not inherent in the design. They may be due to a machining practice that can be changed easily to avoid sharp corners.

Why Crack Testing Helps

Perhaps you have a natural question as to why an engineered nondestructive test such as Magnaflux,

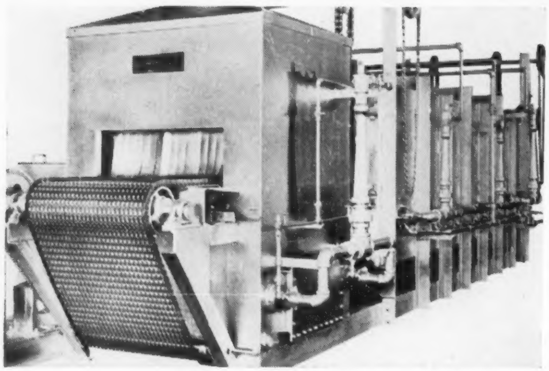


Fig. 6—This crack, shown by Magnaglo, occurred during heat treat because of the sharp corner at the change of section in this part as designed. Often, minor design revision can eliminate the sharp corner to avoid cracking.

Magnaglo, or Zyglo need be used as methods of control whereby action for the elimination of cracking is indicated. There are four or five factors that make these methods particularly useful for such a production tool.

First, all of these methods put an indication right on the part itself, to mark the actual defect so that it can be seen and understood by anyone. This is of particular advantage to the production man because the cracks can be easily seen and their origin understood. Thus he is in a position to correct the cause of cracking whether it be heat treat, previous processing, or inherent defects. The shape and location of the crack is a direct clue to the cause. This is especially true for heat treat cracks which come from 4 or 5 specific causes, and which differ distinctly in shape and location depending upon the cause. When the cracks are so clearly shown, the broad experience in the heat treat department quickly makes the cause recognizable and suggests the cure. In this manner the heat treater can exercise good defect prevention at many places in the manufacturing processes.

Second, the methods are nondestructive. No part is injured when it is tested. Thus, a sampling test can be run on useful production parts without destroying any part.

Third, the methods are low cost to use. Any process used for production must cost less than it saves in production costs. With these methods where each part can be tested in a few seconds, and much expensive waste prevented, it is easy to save much more than the cost of the sampling test.

Fourth, all surface defects and cracks are shown with great reliability. A crack that is not visible without testing can be just as serious and cause as much trouble to heat treat as one that is visible. With a test method that shows all cracks, the judgment as to seriousness is not based upon guessing but upon positive and thorough knowledge plus experience

Fig. 7—Testing axe heads after heat treat, Magnaglo shows several distinctly different types of cracking present. Experienced heat treaters find these due to different causes, each of which is corrected to greatly reduce cracking of parts.

Fig. 8—Normal appearance of axe heads from Figure 7 shows how completely invisible these serious cracks are to the naked eye.

with the methods that develop with a few weeks of use.

Fifth, these test methods are simple to use. Thus, the set-up man or heat treat foreman can be easily trained to test the kinds of parts for which he is responsible. He can do the testing in a few minutes, as a small part of his regular job and apply his experience and testing results to correct any adverse conditions.

Case History: Trouble Shooting in Axe Manufacture

The Collins Axe Company of Collinsville, Connecticut takes great pride in maintaining a very high quality product, with precision heat treating in making axe heads and other impact cutters. For many years a careful Hammer Test was used on all axe heads before shipment. Eventually Collins raised the question of whether this destructive test really provided the desired reliability. The Magnaglo fluorescent magnetic particle nondestructive test was carefully investigated and installed when it offered full reliability and equal production rates without increase in costs.

In addition to vastly improved reliability and fully ample speed, Magnaglo provided a most valuable added benefit,—to aid their sensitive heat treat hardening process. Fig. 7 is a graphic demonstration of this. The Magnaglo indications on the large axe head on the left and the small one in the center show cracks whose cause is found in the heat treat. The factory personnel have further developed their ability to find causes to know that this "corner" type of crack is caused by quenching. The small "edge" crack shown on the third axe head is found to be caused in the heating cycle. Mr. G. F. Whitney, the Plant Engineer, feels that these cracks are caused by little nicks or stress raisers which open into cracks while the heads are in the heat treating furnace. Mr. Whitney has gone so far as to say, "The location and type of crack permits us to determine the cause of the crack. We also believe with optimum hardening we must expect a certain percentage of crackage, that is, unless we find a certain amount of one type of crack, we feel that our hardening operation needs correction".

Naturally, the Collins Company has found that cracks have other causes too, but each cause has its own crack pattern, and the benefit is in being able to correct the cause without delay. Thus, a minimum number of defective parts is produced, heat treating and other processes are more closely controlled, and higher production is possible with existing plant equipment. Fig. 8 shows the same cracked axe heads as they would appear in visual inspection. Even if one of them broke in the Hammer Test, it would be impossible to tell easily what type of crack had been present.

Case History: Removing Danger from Chisel Breakage

What you can't see *can* hurt you! The chisel at the left shown in Fig. 9 looked perfectly good until it broke. It failed in use, and let go a chip that luckily "missed", but could have seriously injured the user. At the right in the photo you see *why* the chisel broke. That chisel was from the same lot. Tested with Magnaglo the invisible heat treat cracks showed clearly under black light. These are the cracks that cause the other chisels to break, and three are readily seen.

Once the condition was recognized, correction of the cracking was obvious and simple. Magnaglo was used during heat treat to control and eliminate the variables in heat treat that caused the cracks. Variations in water quench temperature were found to be the major cause. With this inspection control, production runs regularly made safe chisels, free of cracks.

(*Continued on page 28*)

Right Or Wrong In

LABOR RELATIONS

> **Editor's Note:** *This department presents, in each issue, a round-up of day to day in-plant problems and how they were handled by management. Each incident is taken from a true-life grievance which went to arbitration. Sources of these cases will be given upon request.*

Can You Fire An Employee For Leaving His Job Before The "Quit" Whistle?

What Happened:

About 11:30 in the morning, the Company President was walking towards the plant entrance when he spied Ewell Fergeson, (an employee he knew) walking towards his car. The President called to Ewell and told him to report to his foreman for being off the job prior to the lunch whistle. Ewell said he would and went to lunch anyway. He returned at 12:45, punched his timeclock and reported to his supervisor. When the foreman checked Ewell's timecard, he discovered that someone had apparently punched out for the employee at lunch because the card showed a 12:00 noon exit, in spite of the fact that he was seen outside the plant at 11:30. Ewell maintained ignorance as to who punched his time card. He was given an indefinite layoff until he told who did the punching out for him. A few days later when he still refused to proffer the information, he was fired. Ewell took his case to arbitration. He charged the Company was wrong on several counts:

1. Management can't discipline an employee by giving him an "indefinite layoff". Punishment must be specific and definite, he maintained.
2. Firing was not justified because his offense was not *that* serious. Sure he left early one day without permission, but that's not a capital offense, he said.

Was Ewell: RIGHT ☐ WRONG ☐

What Arbitrator Gerald A. Barrett Ruled:

"The original penalty of an indefinite layoff plainly lacked proper cause in this case because it had no specific duration. If the Company felt that Fergeson's failure to explain the entry on his time card was an offense which warranted the imposition of discipline, it had the duty of weighing the degree of the offense and then imposing a sanction consonant with the offense. A layoff "until an explanation is given" is a wholly unreasonable and insupportable penalty under this contract. The only offense of which Fergeson may fairly be said to be guilty is his brief anticipation of the noon whistle. Discipline in some degree is warranted for this offense, and the Arbitrator does not condone his action. But the penalty of discharge for such an offense, particularly when there is no prior record of discipline against Fergeson, is a gross violation of "proper cause." The maximum penalty which the Company could conceivably have imposed, allowing the fullest latitude for the exercise of managerial discretion, is a layoff of one week and the award therefore so provides."

Can You Fire A Union Official For Using "Abusive Language" Towards A Supervisor During a Heated Argument?

What Happened:

John Simmons was chief steward and it was his job to handle grievances. One morning while walking through the plant, he ran into William Vickers, a supervisor. "John", the foreman said, "I have an answer to a grievance you filed yesterday. Here it is." Simmons took the slip of paper and went into a corner to read it. A moment later, his face flushed, he ran up to Vickers and began arguing with him about the grievance answer. Tempers flared, but it was Simmons, the Union man, who ended the discussion on a note of abuse and profanity. This all took place in front of other employees. The next day the shop steward was fired. When the issue came to arbitration, Simmons admitted getting angry and using indelicate language. But such language, he said, was "shop talk". "Stewards are not expected to talk like sissies

(Continued on page 32)

Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Blanking Die of Lehigh H Produces 15,000 Shotgun Hammers Between Grinds

A minimum of 15,000 shotgun hammers between grinds, with occasional runs as high as 20,000—that's the kind of performance they're getting with Bethlehem Lehigh H in a blanking operation at Milford Tool & Die Co., Milford, Mass. And the operation isn't easy, for it involves an intricate section, heavy weight of stock, and heavy scale condition.

The die is hardened to Rockwell C 59-60, and operates in a 70-ton press. It blanks 8620 hot-rolled alloy steel, 1/4 in. thick, the finished part looking much like a piece to a jigsaw puzzle. From 0.004 to 0.006 in. is removed in redressing.

Lehigh H is our special-purpose high-carbon, high-chromium tool steel. It is easy to machine, and undergoes minimum distortion in heat-treatment, resulting in high compressive strength. Lehigh H is a deep-hardening steel. It has good wear-resistance, and is safe for intricate dies having sharp corners.

If you would like to try Lehigh H in your shop, you'll find your tool steel distributor anxious to be of service. Call him at any time. Lehigh H may also be obtained direct from our mill depot.

NEW COLOR FILM ON TOOL STEEL

You'll like our new educational motion picture, "Teamwork." The film takes you behind the scenes in describing the manufacture, quality-control, heat-treatment, and end-uses of Bethlehem carbon, oil- and air-hardening, shock-resisting, hot-work, and high-speed tool steels.

"Teamwork" is in color, with sound. It is on 16-mm film, and has a running time of 30 minutes. It's ideal for showing to distributors, die-makers, machine-tool manufacturers, heat-treaters, machinists and technical societies, as well as engineering students.

If you would like to borrow a print, write to Publications Department, Room 1005, Bethlehem Steel Company, Bethlehem, Pa., selecting a showing date as far in advance as possible.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Multiple Tools Improve Hot-Work Tool Life

All hot-work tools are subject to heat-checking, a type of surface-deterioration consisting of shallow cracks, usually in network form, which lengthen and enlarge gradually during service. The cracks stem from the repeated thermal stress set up each time the tool is used. During use, portions of the tool surface are heated rapidly by contact with the work, causing expansion; subsequently natural cooling, or some type of forced cooling, causes contraction. Repeated cycles of expansion and contraction produce stresses which lead eventually to heat-check cracks which shorten tool life.

If multiple tools are used alternately, the severity of thermal stress in each operation is decreased, thus retarding heat-checking, and lengthening tool life. A typical example is in hot-piercing punches. Often as many as six punches are provided, and used alternately in a rotating fixture which permits rapid placing and removal of the tools. The life of each tool is often doubled in this manner. However, wherever multiple hot-work tools are used, some degree of improvement in tool life may be expected.

HEAT TREATING HINTS

In our September-October issue we published in this department an article entitled "Overcoming Brittleness" written by D. R. Edgerton of the Lindberg Engineering Company, Chicago, Ill., and editor of their publication called "Heat Treating Hints". Shortly after publication we received a letter from Hiram Brown, Chief Metallurgist of the Solar Aircraft Company, Des Moines, Iowa, taking issue with several points in Mr. Edgerton's article.

The resultant exchange of correspondence was of such significance for the additional information that was received, that we publish it here with their permission.

Metal Treating Institute
271 North Avenue
New Rochelle, New York

Gentlemen:

I have just finished reading the September-October issue of METAL TREATING, and I would like to offer a few comments on one of the heat treating hints "Overcoming Brittleness" which appears on pages 28 and 32 of that issue.

It may seem presumptuous to take issue with an experienced heat treating company such as Lindberg but there are several technical factors that do not tie in with the information given by Mr. D. R. Edgerton in his brief article. First of all he states that the 410 material was slow cooled overnight to 800-1000°F and then aircooled to room temperature. Normal procedure calls for 410 to be cooled to 1100°F and then air cooled to room temperature. Slow cooling in the range of 800-1000°F is a common cause of brittleness for this type of material. It does not necessarily relate to the migration of carbon to the grain boundary or grain coarsening. Material slow cooled through the above mentioned range will often show severe embrittlement and coarse looking fracture when tested in impact. However, the material in most cases passes all other requirements such as strength, hardness, elongation, and normal bend test.

I should like to call your attention to the statement that the correction was attributed to the fact that a "second treatment will usually overcome the abnormality." This is true but you will note that the reheat treatment states that the material was heat treated at 1850°F and air quenched prior to draw-

ing at 450°F. This is not the same treatment that resulted in the brittleness, since the material apparently was not slow cooled through the brittle range. Had this latter heat treatment been applied to the material in the first place brittleness might not have been encountered. This factor was not mentioned in the case history and I think that it is significant. I think that the correct statement would have been that a reheat treatment will overcome the brittleness provided the material is not slowly cooled through the range of 800-1000°F.

HIRAM BROWN
Company Chief Metallurgist

Mr. Hiram Brown,
Chief Metallurgist
Solar Aircraft Company
Des Moines 5, Iowa
Dear Hi:

Far be it from me to start an argument with a good practical metallurgist and one for whom I have the highest respect!

Maybe we can agree that regardless of steel analysis, it is poor practice to finish a forging on the hammer in the higher forging range. Most authorities agree that 1600-1700°F is the proper finishing range and that finish forging above that range or reheating of a nearly finished forging to 2150-2200°F without adequate subsequent reduction may promote grain growth.

Whether the time required to furnace cool a lot of forgings from 1100°F to 800°F would promote blue temper brittleness — I don't know. Authorities with whom I have checked agree only that slow cooling must be continued well below 1500° on 410 Type Stainless and some cool to 350°F as a precaution against cooling bursts.

It has been our experience that a normal treatment will sometimes not overcome the grain growth and that a second treatment or "double treatment" will help to refine the grain and improve the impact strength with accompanying loss of machinability. Perhaps my point of "double treatment" was not sufficiently clear.

I certainly do agree that "temper brittleness" can occur in quenched parts of 410 Stainless drawn in the 800°F - 1100°F range and slow cooled. I honestly never encountered that condition in cooling a forging and would certainly appreciate your advising such embrittlement that you have experienced.

Thanks for your comments and criticism.

D. R. EDGERTON
Lindberg Steel Treating Company

D. R. Edgerton
Lindberg Steel Treating Company
Melrose Park, Illinois

Dear Dave:

Thank you for your letter of January 5 in answer to my letter of November 9 concerning heat treatment of 410. I am not disagreeing with your comments concerning the finishing range of temperature for this material. The only objection I found was in the heat treating of the parts where they are allowed to slow cool below 1000°F. We have had actual experience with bar stock of all sizes which was allowed to slow cool by the mill before shipment to us. In such cases impact resistance was extremely low,

(*Continued on page 33*)

NEWS TO HEAT TREATERS...

Heating Equipment Association Meeting

The Industrial Heating Equipmen Association held their annual business meeting in Chicago this past February and elected the following officers: E. E. Staples, Hevi Duty Electric Co., president (see cut); W. E. Holcroft, Holcroft and Co., vice-president; and R. E. Whittaker, Swindell-Dressler Corp., was re-elected treasurer.

One of the highlights of the session was the speech given by John Graham, chief metallurgist, International Harvester Co., Chicago, and one of the good customers of many members of the association. He stressed the fact that one of the big problems facing equipment manufacturers was how to convince industry of the need to replace many old furnaces with new and more efficient ones. He made several suggestions as to how to work on this problem, and stated that he was convinced that it was becoming more expensive to use old equipment but that it was the job of the equipment suppliers to explain to the users what they need in the way of new equipment because frequently the builders know the needs of the customer more than the customer does himself.

Another interesting part of the meeting was an afternoon roundtable discussion session in which the members and guests were divided into nine groups each headed by a discussion leader and each group discussing a different topic of interest to the association.

It was also pointed out that in 1955 the makers of industrial heating equipment more than doubled their 1954 business and that the prospects for 1956 were excellent because 20% of the '55 orders were already placed during December.

Nation's Largest Vacuum Melting Furnace

The nation's largest vacuum melting furnace was tapped recently by Vacuum Metals Corporation at Syracuse, N. Y., under the supervision of James H. Moore, General Manager.

Jointly owned by Crucible Steel Company of America and National Research Corporation, Vacuum Metals was the first commercial producer and the first *fully* integrated producer of vacuum melted metals and alloys in the country.

Dwarfing the earlier 300 and 600 pound furnaces, the new 2,200 pound vacuum melting furnace is a far cry from the small crucibles that produced the first samples of vacuum melted metals in the laboratories of National Research Corporation more than ten years ago.

The design, which was based on five years of operating experience with such semi-continuous vacuum furnaces, was under the direction of Dr. M. H. Hnilicka of the Research Division of National Research Corporation. The furnace was built by the Equipment Division of National Research and installed by the engineering department of the Sanderson-Halcomb Works of Crucible Steel, under the direction of Mr. W. K. Lowe, Chief Engineer. The new unit increases by 60 to 75 tons, the monthly potential supply of vacuum melted metal for industry.

The products of this process are characterized by cleanliness and low gas content, with consequent higher elevated temperature strength and ductility, and increased fatigue and impact strengths. They have proven superior for use in critical applications in aircraft engines and in machinery components requiring a quality unattainable from conventional metal.

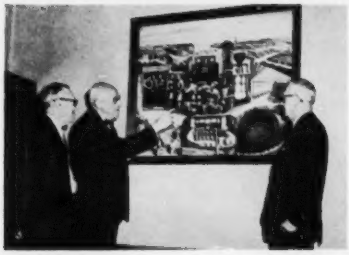
Metals melted in a vacuum are superior to conventional atmospheric melted metals, particularly where such mechanical properties as stress-rupture strength and ductility, fatigue strength, notch ductility and impact resistance are prime factors.

Experimental evaluations and production trials have been made from vacuum-melted metals in such industries as aircraft, automotive, electronics, bearing, tool steel, nuclear energy, and others. Most are subject to heat treatment of some sort. Currently, investigations as to the effects of vacuum melting upon heat treatability indicate no major changes in either result or heat treat process are required. More uniform results could be expected because of structural uniformity and metallic purity. It is safe to say at this point, however, that vacuum melted metals will present no problems to the heat treater.

For further information circle No. 1

100th Anniversary

One of the nation's oldest and largest manufacturers of refractory



products, The Robinson Clay Product Co. of Akron, Ohio, is observing its 100th anniversary in 1956.

Robinson manufactures a complete line of high-quality refractories, including firebrick of all types for super-duty, high-heat, intermediate and low heat applications; insulating firebrick in all standard and special shapes; castable refractories and bonding mortars for super-duty and high-heat duty service. One of the clay industries most diversified firms, Robinson is also known for its complete line of vitrified clay pipe, related clay products and a wide selection of pottery, china and glass.

For further information circle No. 2

Endothermic Generator

A new laboratory-size endothermic generator is the most recent addition to the extensive lines of controlled atmosphere processing equipment produced by Ipsen Industries, Inc., Rockford, Illinois.

This G-150-E electrically-heated generator is used for the small-

scale heat treatments usually required in the laboratory or tool room heat treat department. Rated output is approximately 150 cfh of prepared atmosphere gas, but this output can be increased by approximately 50% when required.

Although the generator is specifically designed for use with the Ipsen RT-25 laboratory furnace, it can be used with any controlled atmosphere furnace of proper size.

The generator is housed in a compact cabinet with operating instruments and controls conveniently located in front.

For further information circle No. 3

Park Chemical Personnel

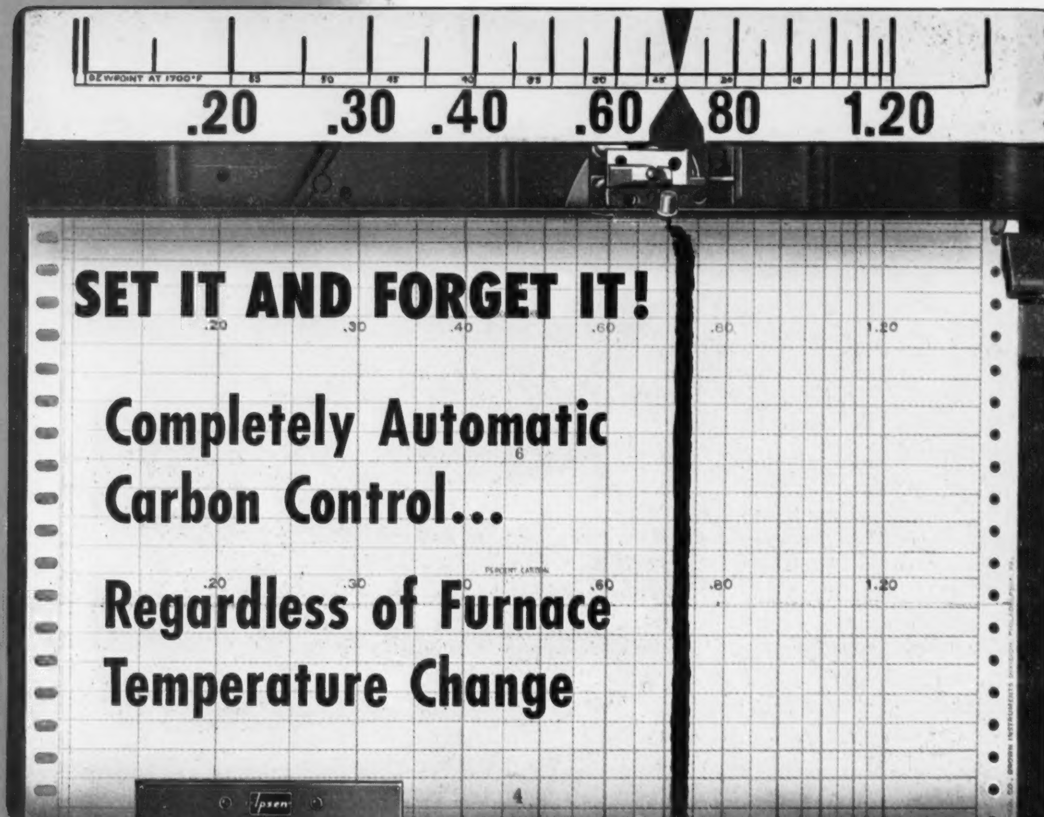
Two personnel changes have been announced by the Park Chemical Co., Detroit, Michigan.

William P. Askew, who has been in the Specialty Division of the company since 1946, will work out of the home office as sales representative of the Heat Treating Materials Division.

Robert H. Settles has joined the company as sales representative of the Heat Treating Materials Division in the New England states.

Plating Room

Orderly arrangement of plating



The Ipsen CARBOTRONIK carbon controller automatically coordinates furnace temperature and dew point to continuously provide any desired carbon potential from 0.20% to 1.25%. Enriching gas additions are made at the furnace and accuracy is ± 0.02% carbon over a range of 1400° F to 2000° F.

Dew points are measured every 5 seconds by a voltage type element. This sensing element is unaffected by ammonia or any other atmosphere gas and it does not require calibration. The operator merely sets the selector to desired carbon content and any furnace temperature changes are compensated for automatically.

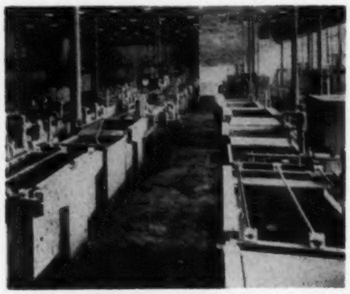
The CARBOTRONIK is a self-contained unit and can be placed at any distance from the furnace or generator being controlled. It records and indicates directly in percent carbon.

IPSEN INDUSTRIES, INC.
717 South Main Street, Rockford, Illinois

AUTOMATIC Ipsen HEAT TREATING UNITS

equipment enables Westinghouse Electric Co. to process thousands of electronic parts daily in any of 16 different ways at its Air Arm plant in Baltimore.

Westinghouse coordinated equipment layout and operating procedures for this plating room with engineers from Hanson-Van Winkle-Munning Co., Matawan, N. J., who specified and supplied processing equipment.



First three tanks in photo (left) are for electrocleaning, cold rinsing and pickling. Tin, cadmium and zinc plating barrels are at the end of this processing line. The line on the right handles electrocleaning nickel and chrome plating. All tanks in this room are arranged so that metal parts are routed as quickly as possible through the various processes.

For further information circle No. 4

New Representative

Heatbath Corporation announces the appointment of James B. Wheeler as Technical Representative for the Northern Ohio area.

Mr. Wheeler has been closely associated with heat treating and metal finishing for the last ten years, first as Superintendent of Elyria Plating Company and later as Service Representative for General Supply Company in Cleveland.

Mr. Wheeler will work out of the office and warehouse at 3540 Croton Avenue, Cleveland 15, Ohio, telephone Henderson 1-4900.

Revised Stainless Steel Designations

Major changes have been made in the published designations for stainless steel types by the American Iron and Steel Institute. The newly announced changes are the result of improved industry practices, the elimination of government controls and an effort to provide a wider degree of flexibility in working stainless. They give the user even greater uniformity and dependability in these special requirement steels.

New additions to the 300 and 400 series bring the total of standard designations to 35. Changes have also been made in the published analyses for the 501 and 502 heat resisting steels which are grouped with, but not classified as, stainless.

In clarifying the purpose of publishing designations and analyses for "Standard Types" of stainless, American Iron and Steel Institute pointed out that they are designed to reflect current industry practice. Type numbers are provided for the convenience of steel makers and users to simplify the specification of these heat and corrosion resisting steels.

For further information circle No. 5

Michigan—Standard Merger

Consolidation of two long-established alloy casting companies is announced by "Misco"—the 48-year-old Michigan Steel Casting Co. The latter firm has acquired the Standard Alloy Co. of Cleveland, moving its operations, patterns, and certain of the production personnel into the larger plant at Detroit. The Cleveland plant has been sold.

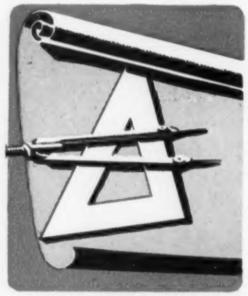
"Our name now becomes Michigan-Standard Alloy Casting Co.," states Jack Bean, shown above, president of Michigan Steel Casting Co. "We will continue to be a divi-

(Continued on page 24)

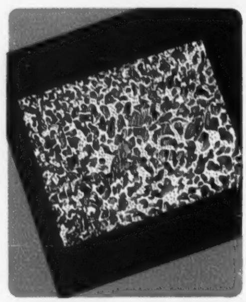
6 reasons for checking you

HE PROVIDES . . .

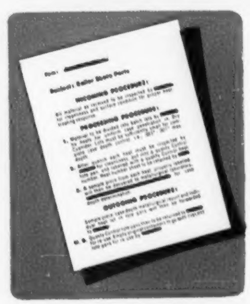
Guidance in Steel Selection and Design

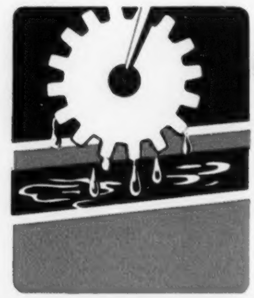


Metallurgical Understanding of Metal Properties

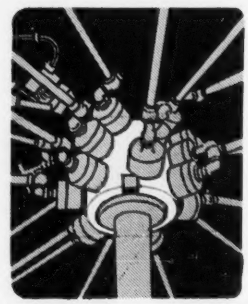


Assistance in Proper Preparation of Parts for Heat Treating

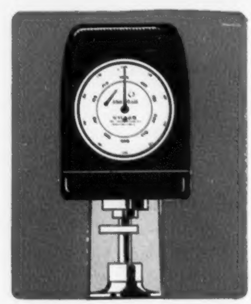




Knowledge throug Experience of the Right Heat Treat for the Job



Extensive array of Equipment and Facilities



Final Laboratory and non-destructive Testing

Whenever your production requirements for a new product or the redesign or improvement of an old one mean the installation or expansion of heat treating activities, it will pay you to check with your Commercial heat treater before tackling the job yourself.

The 6 basic reasons for this are shown above.
Remember the Commercial Heat Treater has the skill, the experience, the equipment;—all under one roof ready to serve you.

MTI MASTER CRAFTSMEN
METAL TREATING INSTITUTE

METAL TREATING

Commercial Heat Treater first!

ALABAMA

outhern Metal Treating Co., Inc.
3131 10th Ave., North, Birmingham 4

CALIFORNIA

ollywood Heat Treating Co.
6902 Santa Monica Blvd., Los Angeles 38
indberg Steel Treating Co.
2910 S. Sunol Drive, Los Angeles 23
alloy Heat Treating Co.
11648 So. Atlantic, Lynwood
ook Induction Heating Co.
4925 East Slauson Ave., Maywood
exter Metal Treating Co.
1026—77th Ave., Oakland 21
ndustrial Steel Treating Co.
1549—32nd St., Oakland 8

COLORADO

etal Treating & Research Co.
4110 Fox St., Denver 16

CONNECTICUT

ommercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6
anley P. Rockwell Co.
296 Homestead Ave., Hartford 5

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enecca Heat Treating Co.
124 S. Batavia Ave., Batavia
ccurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
hicago Steel Treating Co.
333 North California Ave., Chicago 12
ura-Hard Steel Treating Co.
2333 West Deming Place, Chicago 47
earson Industrial Steel Treating
5757 Ogden Ave., Chicago 50
erfection Tool & Metal Heat Treating Co.
1756 West Hubbard St., Chicago 22
ed A. Snow Co.
1942 West Kenzie St., Chicago 22
merican Steel Treating Co.
P. O. Box 225, Crystal Lake
klund Metal Treating, Inc.
721 Beacon St., Loves Park
ndberg Steel Treating Co.
1975 No. Ruby St., Melrose Park
. T. Muehlemeyer Heat Treating Co.
1531 Preston St., Rockford
U. Scott & Son, Inc.
1510 First Ave., Rock Island

MARYLAND

aryland Tool Company
111-13 Hollingsworth St., Baltimore 2

MASSACHUSETTS

w England Metallurgical Corp.
9 Alger St., South Boston 27
rter Forge & Furnace, Inc.
74 Foley St., Somerville 43
eenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Anderson Steel Treating Co.
1337 Maple St., Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Michigan Steel Processing Co.
3120 Denton, Detroit 11
Standard Steel Treating Co.
3468 Lovett Avenue, Detroit 10
Vincent Steel Process Co.
2424 Bellevue Ave., Detroit 7
State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8
American Metal Processing Co.
12000 East Nine Mile Road, Van Dyke

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900 East Hennepin, Minneapolis 14

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Metallurgical, Inc.
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Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

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American Metal Treatment Co.
Highway 25 and LaFayette St., Elizabeth
Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst
Bennett Heat Treating Co., Inc.
246 Raymond Boulevard, Newark 5
L-R Heat Treating Co.
107 Vesey St., Newark 5
Temperature Processing Inc.
228 River Road, North Arlington
Metro Heat Treat Corp.
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Fred Heinzelman & Sons
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Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38
Metro Heat Treat Corp.
466 Broome St., New York 13
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Rochester Steel Treating Works
962 Main Street, E., Rochester 5
Syracuse Heat Treating Corp.
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Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
George H. Porter Steel Treating Co.
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Reliable Metallurgical Service, Inc.
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Winton Heat Treating Co.
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220 West Cambria St., Philadelphia 33
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1351 N. Front St., Philadelphia 22
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4272 Wissahickon Ave., Philadelphia 32
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Superior Heat Treating Co., Inc.
P. O. Box 1686, Fort Worth 1
Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11
Lone Star Heat Treating Corp.
5212 Clinton Dr., Houston 20

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Hushek Metal Processing Co.
1536-40 West Pierce Street, Milwaukee 4
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
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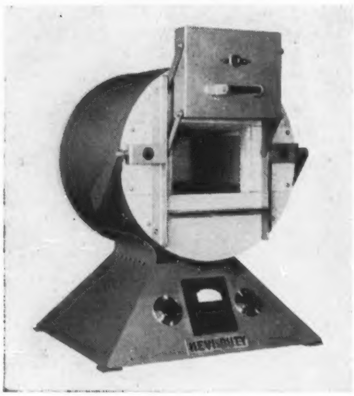
NEWS TO HEAT TREATERS

(*Continued from page* 21)

sion of Consolidated Foundries & Manufacturing Corporation. Our trade name Misco, widely known to three generations in the foundry industry, will be retained."

This Michigan-Standard merger retains the majority of the sales representatives of both companies. In combining operations, Misco is widening its range of products and technical skills.

Muffle Furnace



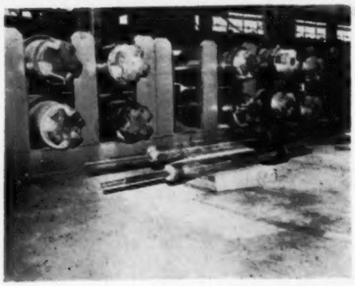
A new large-size, automatically-controlled Muffle Furnace for continuous operation to 1850° F. has been announced by Hevi Duty Electric Company.

This modern styled furnace is a complete self-contained, compact unit with all the necessary temperature indicating and accurate control devices located in the pyramid-type furnace base. Power input is controlled by a 36-step, tap-changing transformer; this along with the controlling pyrometer assures very close temperature regulation.

The heating chamber—inside dimensions 11" x 14" x 8"—is formed by four long-life, "Multiple Unit" heating units which can be arranged to expose the element or reversed to form a muffled chamber. A tight fitting counter-balanced hinged style door swings to an upward position keeping the hot side facing away from the operator.

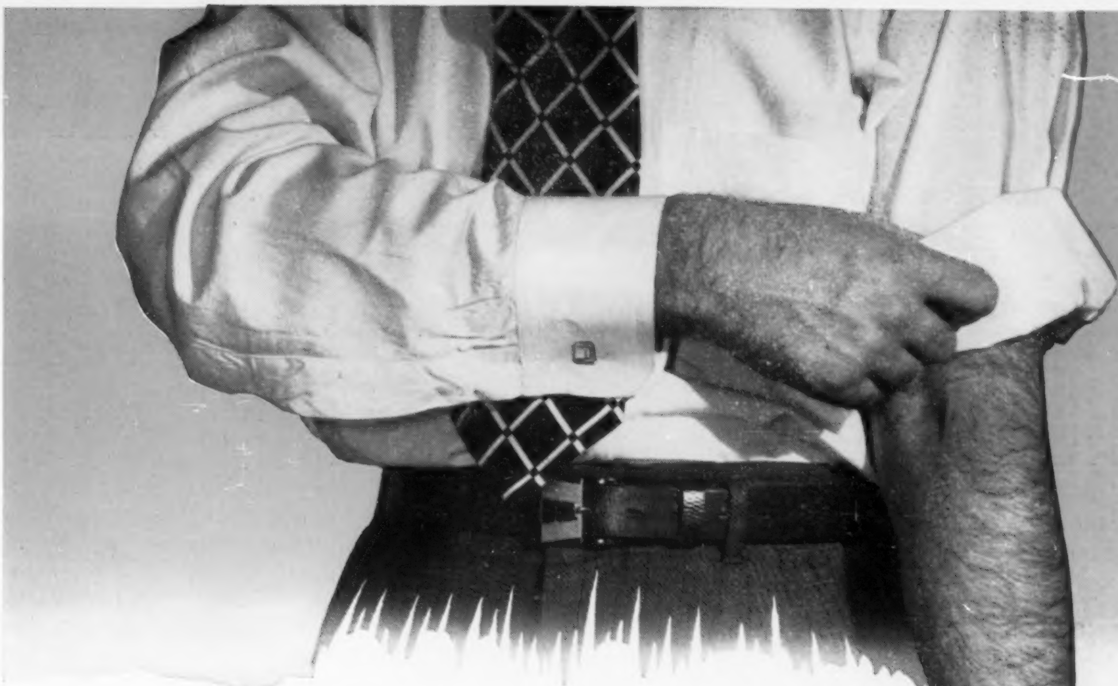
For further information circle No. 6

Ceramic Fiber Reduces Maintenance



Filled with a ceramic fiber material, these two roll sleeves and others like them need repacking about half as often as they used to. Besides lowering maintenance costs, the packing has eliminated a source of sheet damage. Haynes Stellite Company uses the sleeves in the discharge section of a heating furnace at its Wrought Alloy Plant.

The material, Fiberfrax fiber, made of alumina and silica by The Carborundum Company, has increased average operating time per roll, between repacking, to 1,100



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hours—a jump of 500 hours over the old packing material. Temperatures up to 2,150 deg. F. and alternating roll speeds reduced the previously used insulation to powder, which leaked from the rolls and damaged heated sheets as they moved along to the plant's 2-Hi mill. Fiberfrax fiber keeps its properties at temperatures up to 2,300 deg. F. and stays in place despite the rough operating conditions. The rolls, fabricated from 3/16" Hastelloy alloy X sheet, are 78" long and have a 7" O.D. A water-cooled steel shaft runs through each roll.

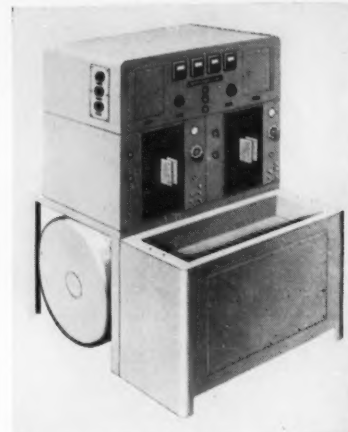
For further information circle No. 7

Harper Promotion Manager

The appointment of Alfred L. Trumpler as Promotion Manager has been announced by Harper Electric Furnace Corp. of Buffalo, New York, manufacturer of high temperature electric kilns and furnaces for the ceramic and metalworking industries.

Trumpler will be responsible for Harper's expanding advertising and sales promotional activities; he will also be active in the company's sales department.

New 30-KW Induction Heater



A new 30-kw induction heater, either totally enclosed water-cooled, or open air-cooled, is available from the Westinghouse Electric Corporation. The 30-kw induction heater is a "building block" unit that includes all elements needed for induction heating. Coils, for the specific applications can conveniently and easily be added. Three basic units: (1) the 30-kw 10,000 cycle water-cooled m-g set with its generator control; (2) the high frequency output cabinets; (3) the work table—can be combined and adapted to fit a multitude of induction heating jobs. For example, 32 standard combinations are available.

This flexibility makes the unit ideal for hardening and heat-treating operations, metal-joining, hot-heading and forging.

A supporting frame provides mounting for the generator control and output cabinets. This structure opens on all sides and makes servicing to the motor-generator set easy. The overall dimensions of the 30-kw unit are 48 inches wide, 59 inches deep and 77¾ inches high.

For further information circle No. 8

Flexible Furnace

A single salt bath furnace of the G. H. Leland Company, Dayton, Ohio, originally purchased only for *one* operation, carburizing, is now being used for *four* different operations: carburizing, brazing, simultaneous brazing and case hardening,

(Continued on page 29)

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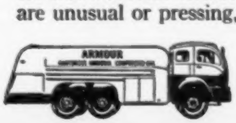

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(Continued from page 13)

Fig. 9—At the bottom, the results of cracks in a chisel were apparent when a chip flew off to barely miss the user. At the top, Magnaglo tests of similar chisels show the exact cause of the failure and the nature of the cracking causes which were eliminated to assure future manufacture of safe chisels.

Value Up to the User

The value that can result depends upon the user, when Magnaglo and Zyglo are used as production tools to control heat treat. Used blindly, these methods can only show cracked parts and lead to throwing away finished products. When the production man uses them to find the cause of cracking, these methods can tell him exactly what kinds of cracks are occurring, whether they are occurring in production, or if they are due to defects that are inherent in the material before heat treating. Correction of the cause is again in the hands of the man using the test method. When he follows up and corrects the causes he can improve the efficiency of his department,—increase overall plant production,—and reduce heavy losses to his company. Such losses would otherwise occur when parts are heat treated in large quantities only to find later that high percentages have been cracked. Rejection of finished heat treated lots can sometimes run to prohibitively high percentages. This cannot happen if sampling testing is carried out before and during heat treating. ■ ■ ■

and hardening. This small 65 Kw heat treater's "Shopsmith" produced by Ajax Electric Company, Philadelphia, saved approximately $37,000 during an 8-month period.

Over 500 different punchings, stampings, and machined parts for rotary solenoids, circuit selectors, and relays are processed by immersing them for varying periods of time in the liquid salt bath. Having working dimensions only 24" long x 15" wide x 20" salt depth, the furnace uses a water soluble carburizing salt that is operated at temperatures from 1550 to 1650°F.

One "secondary" operation, simultaneous brass brazing and carburizing, eliminated three material handling operations and cut unit costs 80%.

For further information circle No. 9

California Doran Expanding

A facilities expansion program at California Doran Heat Treating Co., Los Angeles, will increase production capacity by 40 per cent and make the firm the largest and most complete heat treat facility in the West, R. P. Archer, president, has announced.

Already partially completed, Cal Doran's expansion program will take advantage of semi-automatic and mechanized equipment and will make available the latest techniques in heat treating the heavier, tougher materials that are stemming from the continual advances in metallurgy.

Archer said that new equipment and machines, now being installed, together with purchase of additional land and new construction, will raise Cal Doran's investment for new equipment and facilities during 1955 to $250,000. The new facilities are expected to bring large savings to manufacturers of commercial items who have been unable to compete with eastern manufacturers because of the lack of production heat treat facilities on the west coast.

Among the special furnaces being installed is a unique mobile vertical steel heat treating furnace with 3-zone control. Mounted on rails and towering 22 feet above the plant floor, the bottom-quenching, bottom-loading furnace structure will roll over a series of quenching pits embedded 20 feet into the building's foundation. The furnace will be the only one of its type on the West Coast available to the trade. It will accommodate parts such as aircraft pylons, fuel cells, fabricated tank sections and other parts up to 16-ft. long by four-ft. diameter.

Other new equipment includes a completely mechanized pusher-type hearth 36-ft. long for heat treating parts for the oil tool industry, and new blasting machines that increase grit blasting capacity, including sand and vapor, by more than 50 per cent. Also three more carbonitriding furnaces, and additional endothermic and exothermic generators, will enable California Doran to offer additional controlled atmosphere heat treating services and facilities.

Ultra-high Temperature Furnace

Salem-Brosius, Inc., Carnegie, Pa., one of the nation's largest designers and manufacturers of industrial furnaces and heat treating equipment, was appointed exclusive agent for the sale and licensing of a new, ultra-high temperature furnace and the processes of Metals Chlorides Corp. of Middleport, N. Y.

The new furnace operates at temperatures in excess of 4,000 degrees Fahrenheit and is designed for continuous tonnage halogenation of oxides, ores and carbides at temperatures near to, or above, the vapor stage temperature of most metals and metallic compounds.

For further information circle No. 10

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Springfield: The Chemical Corp. 54 Waltham Avenue Tel. Republic 9-5601
West Springfield: Barker Chemical Co. P.O. Box 173. 101 Circuit Ave. Tel. RE 3-1007
Worcester: Brewer & Company, Inc. Industrial Chemical Division 45 Arctic Street

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Brooklyn: Tex-Ite Products Corp. 885 Flatbush Avenue Tel. BU 2-8112
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New York: E. M. Sergeant Pulp & Chemical Co. 7 Dey Street Tel. WOrth 2-4340
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CONTROLLED ATMOSPHERE EQUIPMENT

(Continued from page 7)

where K depends on temperature only, is unity at 1500° F., and increases with temperature. Now for a given temperature the composition varies with the air/gas ratio, the higher ratios increasing the CO_2 and H_2O values. When air infiltrates in the hot chamber the effect, relative to CO_2 and H_2O is the same as though a higher ratio of air to gas had been employed in making the carrier gas.

In the preceding analysis, the assumption of completeness of the reactions is not quite a correct one since a certain very small amount of methane does not react but rather remains in equilibrium with the hydrogen content of the products. We have three reactions by which we may evaluate the carbon potential of the carrier gas, two of which concern the water gas reaction constituents, (Eq. 3), and the third from the methane-hydrogen equilibrium.

5. $2\,CO = CO_2 + C$
6. $H_2 + CO = H_2O + C$
7. $CH_4 = 2\,H_2 + C$

These three reactions differ from reaction (3) in that there are changes in the gas volume, whereas for the water gas reaction the volumes of the products and reactions are identical. Applying the mass law, and noting that we must use the actual pressures of the gasses instead of the percentages, we have, for a gas mixture whose total pressure is one atmosphere (which is the condition we have taken for gas applications);

8. $100 \times \%\,CO_2/(\%CO)^2 = K_2/P_c$
9. $100 \times \%\,H_2O/(\%H_2 \times \%\,CO) = K_3/P_c$
10. $(\%H_2)^2/(100 \times \%\,CH_4) = K_4/P_c$

Since our operation is at one atmosphere, and since the solid carbon exerts unit pressure, we may evaluate from the K values the equilibrium compositions for steel at austenizing temperatures, making the simplifying assumption that saturated austenite has unit pressure ($P_c = 1$), and that the relative pressures of carbon will correspond to the degree of saturation.

The application of the gas composition data to actual or definite processes will be attempted in later discussions. For the present, let us consider the heating process in connection with atmospheres. A high heat content stored in the refractory structure, a fast heat input as the charge is made, with a lowered heat input as the charge attains the process temperature, and a vigorous recirculation of the atmosphere through the charge and past the heating source in controlled paths, are desirable features from the viewpoint of process control. Additions to the charge of carbon, or of carbon and nitrogen are made through supply reactions occurring at the surface of the processed pieces, and the rate at which the supply is made are functions of time and temperature. Here the load factor, discussed briefly for Position 1, also affects the uniform application of heat as well as of gas supply to the charge.

Perhaps the heating of a small piece charged cold into a chamber of large heat content held at the process temperature, will serve to illustrate the rationale for uniform heat application to a heavy charge. For the small piece heat supply is no problem, since the total heat to be absorbed by the piece is such a small percentage of that stored in the heated structure, it is found that the rate at which the piece absorbs heat is almost directly proportional to the difference at any time between the temperature of the piece itself and the temperature at which the chamber is held; that is, the heat absorption rate is highest when the piece is first charged, and this rate gradually diminishes to zero as the piece approaches the furnace temperature. For the heavy charge, we must supply a great amount of heat in proportion to the heat content of the chamber. We can safely supply heat at a fast rate early in the heating period, but as the process temperature is approached, and the ability of the charge to absorb heat is diminished, the rate of heat input to the charge must be reduced to insure temperature uniformity throughout the charge, before the process temperature is reached. Limiting the heat input rate to the charge, during the latter portion of the heating cycle, is effected by the heat capacitor. This is a high specific heat refractory material which surrounds each of the radiant tubes, and which has a pronounced effect in establishing case depth uniformity.

The Container and Load as Quenched, Position 4

Oil is the common quenching medium for atmosphere processing. The bath should be carefully protected, since oxygen absorbed or entrapped in the oil, may readily cause a stained surface or film on the parts as quenched. The vestibule atmosphere may well provide this protection, when proper steps are taken to provide adequate flow controls.

As the inner door is opened and the charge is moved

"HERE'S AN IDEA!... LET'S WRITE A LETTER TO THE 'WHAT'S YOUR PROBLEM?' DEPARTMENT!"

from the high heat chamber to a position over the bath, an increase in pressure is noted, since the relatively cold gas in the vestibule is quickly heated by radiation from the hot chamber, as well as by radiation from the hot box as it enters the vestibule. During this period of pressure increase, a tandem lowerator allows a simultaneous lowering of the processed charge into the quench bath, and the green conditioned container, 2, into the charging position. This construction allows the new container to be loaded immediately into the hot chamber; the pressure increase phenomenon assuring protection for both container transfers, both out of and into the high heat chamber.

The inner door is closed immediately after loading the green charge into the hot chamber. Since the sources of heat which caused the pressure increase in the vestibule are now removed, there is a contraction of the vestibule atmosphere which causes the vestibule pressure to drop below atmospheric. The resulting inflow of air is controlled by the open slide port in the outer door, thus allowing rapid pressure equalization without contaminating the atmosphere in the hot chamber.

Transfer of heat from the charge to the bath is a convection phenomena, and controlled recirculation of the bath is the most important consideration. The problem here is quite analogous to that in the heating process, as it involves both heat transfer rates and the uniformity of heat abstraction throughout the entire load.

In Part II of this article, which will be presented in the next issue, we will apply the foregoing general principles of controlled atmosphere operations to solve a specific metallurgical problem. ■ ■ ■

LABOR RELATIONS *(Continued from page 14)*

or gentlemen" is the way he put it to the arbitrator. Maybe a warning, but surely not discharge, was his contention.

Was Simmons: RIGHT ☐ WRONG ☐

What Arbitrator Joseph M. Klamon Ruled:

"The Union asserts that the language used was merely 'shop talk' and that the entire incident was too minor to justify discharge. The Arbitrator does not agree. Though the phrases used may frequently be used in jest, banter or even casual argument in the plant, they were of the sort which no self-respecting man should be expected to tolerate when applied to him in anger. In the instant case, the words were used in a way which was abusive, insulting and threatening. They were directed at the Foreman in the presence of other employees. Management has a right to protect the prestige and authority of its Supervision and to uphold discipline and order in its plants. Such a right would be meaningless if it could be required to overlook the extreme and uncalled for verbal attack on the Foreman which occurred in this case. The discharge of the grievant is upheld and the grievance is denied." ■ ■ ■

HEAT TREATING HINTS

(Continued from page 17)

running around 10-15 pounds whereas the same material, after 2 hours at 1350°F, followed by air cooling, would always have impact properties of over 50 foot pounds and usually over 100.

In the double heat treatment which you mentioned for recovery of ductility you did not go through the same slow cooling to 800°F that you did when you obtained the original embrittlement. Therefore, I did not think that the information you presented proved the point that you were trying to make. In other words, what would have happened if, during the second heat treatment, you would air quench from 1850°F and then slow cool to 800°F? We have normally found that the embrittled condition caused by slow cooling through the brittle range is readily relieved by a 1350°F anneal followed by air cooling. If a treatment of this sort had been compared with the 1850°F treatment which you mentioned and also with similar 1850°F treatment slow cooled to 800°F, the results might have been more definite in proving or disproving the point in question.

You might be interested to know that one company supplies 410 bar stock to a customer who wishes to simply snap off pieces of the bar to machine into certain parts. In order to get a material which will readily snap under load, the mill simply puts the material into an annealing furnace, heats it to the required temperature, and allows the material to cool over the weekend in the furnace. I have been advised that this invariably leads to material which will break in a brittle manner in accordance with the needs of that customer.

I hope I have made my objection clear since I am sure that fundamentally we don't have a wide difference of opinion.

HIRAM BROWN
Company Chief Metallurgist

THE APPRENTICE CORNER

SOME QUESTIONS AND ANSWERS ABOUT DECARBURIZATION

By G. E. BRUMBACH, *Metallurgist*
The Carpenter Steel Company
Reading, Pennsylvania

A better understanding of decarb and a thorough appreciation of its possible dangers can definitely help industry improve the general performance of tools and dies.

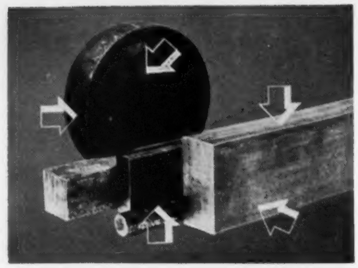
Decarb is present on *all* hot rolled, cold drawn and forged tool steel bars . . . and in working alongside shopmen down through the years we've found that although decarb *may* be passive, it is often destructive, and *always* dangerous!

Q. WHAT IS DECARBURIZATION?

A. There are two decarburized conditions that concern you. (1) The thin layer of decarburized material, often called bark, that appears on the surface of *all* hot rolled or forged steel . . . as well as on cold drawn bars from which the original hot rolled surface has not been removed. (2) The decarb that sometimes appears on tools and dies as a result of heat treatment. Actually, a decarburized surface means that the surface layer is *lower* in carbon content than the steel under the surface. Let's consider first the decarb that appears on tool steel bars.

Q. CAN DECARBURIZATION ON TOOL STEEL BARS USUALLY BE DETECTED?

A. Yes . . . on surfaces of hot rolled bars or forgings. And the thin layer of decarburized material on these surfaces results in a condition as shown in Fig. 1. If you work with tool steels you are likely to see surfaces like this almost every day. However, on *cold drawn* bars decarb is easier to overlook (because the finish is brighter and

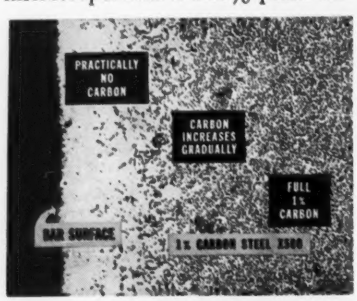


cleaner) . . . even though it is there to almost the same degree as on *hot rolled* bars.

Of course, the appearance of any bar surface doesn't always indicate the presence or absence of decarburization. But a scaly surface should serve as a danger signal and caution should be exercised. And regardless of how the bar looks to the naked eye, decarburization can be easily recognized under the microscope.

Q. WHAT DOES A DECARBURIZED SURFACE LOOK LIKE UNDER THE MICROSCOPE?

A. Fig. 2 represents a cross-section of a 1" x 3" hot rolled tool steel bar photographed under a microscope. It is a 1.00% plain car-



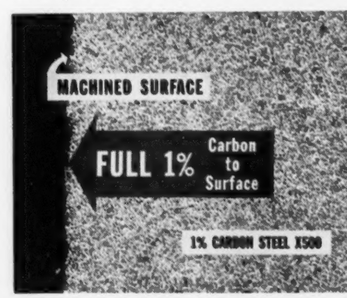
bon steel, magnified five hundred times. In this case, for a depth of about .005" under the surface of the decarburized bar there may be no carbon at all. The carbon content then increases gradually. And at a depth of about thirty thousandths on this piece you can be sure the full carbon content is reached.

Q. DO VARIOUS GRADES OF STEEL DIFFER IN THE DEGREE OF DECARBURIZATION?

A. Yes. The degree to which a bar may be decarburized depends upon the analysis of the steel (some analyses decarburize more readily than others) and also upon the mill practice used during the annealing of the bar. However, *any* amount of decarburization on the surface of a tool steel bar is undesirable . . . and is likely to cause trouble.

Q. WHAT CAN HAPPEN WHEN DECARB IS NOT REMOVED FROM HOT ROLLED BARS?

A. From the heat treating standpoint the difference in carbon between the surface and inside of the bar is usually sufficient to cause cracking or warpage in hardening —no matter *what* the grade of steel. To get full value from a tool or die, it is necessary to have the full carbon content right out to the surface. Fig. 3 is a micrograph of a bar *after* the decarburized surface



has been removed. There's full carbon right up to the surface. A bar of steel like this will have a much better chance of doing the job you expect from it.

Q. WHAT ARE THE DANGERS OF DECARB THAT OCCUR AS A RESULT OF HEAT TREATING?

A. Assuming that your tool or die steel is free of decarb up to this point, it would be a shame to jeopardize its performance by having decarb occur during heat treatment. Here's why: Premature wear . . . cracking . . . or fatigue failure in service are often directly traceable to decarb formed in the hardening process.

To be continued in the next issue.

INSTITUTE NEWS

MTI 1956 SPRING MEETING

The Annual Spring Meeting of the Metal Treating Institute will be held on April 30th, May 1st and May 2nd at the Hotel Roosevelt, New Orleans, Louisiana.

The entire program is not as yet completed at this time of publication, but a partial program has been planned as follows:

MONDAY, APRIL 30, 1956

8:30 A.M.—Get-together breakfast.

10:00 A.M.—President's Welcome.

10:15 A.M.—Presentation—*Subject*: "Heat Treatment of Materials Used in Nuclear Reactors", by W. D. Manley, Assoc. Dir., Metallurgy Div., Oak Ridge Nat'l. Lab.

11:00 A.M.—Discussion.

11:30 A.M.—Presentation—*Subject*: "Metal Treating Institute Affiliate Membership", by F. Heinzelman, Jr., Fred Heinzelman & Sons.

12:00 Noon—Discussion.

12:30 P.M.—Luncheon.

2:00 P.M.—Guided Tour of New Orleans. French Quarter (or golf at New Orleans Country Club).

7:00 P.M.—Dinner at Antoine's—Dancing.

TUESDAY, MAY 1, 1956

8:30 A.M.—Breakfast — Board Meeting in Presidential Suite.

10:00 A.M.—Film—"You Are There at the Bargaining Table", American Management Assoc.

11:00 A.M.—Discussion.

11:30 A.M.—Presentation—*Subject*: "Have You Tried Listening" by W. Wiksell, Louisiana State Univ.

12:30 P.M.—Luncheon.

2:00 P.M.—Harbor Trip—Steamer "*President*" (or golf at New Orleans Country Club).

WEDNESDAY, MAY 2, 1956

8:30 A.M.—Breakfast — Board Meeting in Presidential Suite.

10:00 A.M.—Film — "Mining of Nickel" (in color).

10:30 A.M.—"What's Your Problem?" Session.

12:30 P.M.—Luncheon.

2:30 P.M.—Tour—High Spots of New Orleans.

7:00 P.M.—Reception and Banquet — Entertainment and Dancing.

Reprints Appreciated

Mr. Carl L. Ipsen, Executive Vice President of the Industrial Heating Equipment Association, Inc., Washington, D.C., has written a nice letter of appreciation to Mr. J. W. Rex, president of J. W. Rex Company, Lansdale, Pennsylvania for having received some copies of the reprints of Mr. Rex's article which was published in the September-October issue of METAL TREATING and was entitled "What the Commercial Heat Treating Industy Would Like to Have the Industrial Heating Equipment Manufacturers Develop." Mr. Ipsen said in part:

"The Industrial Heating Equipment Association greatly appreciates your thoughtfulness and generosity in supplying us with reprints of your article appearing in METAL TREATING on the subject of your talk at our Hot Springs meeting last May. You can be sure that your good suggestions for im-

proving the products and services of our membership will be carefully reviewed by the key personnel of member companies. May you be compensated for your fine work at least in part by the improvements in heating equipment that your good suggestions will bring about."

Congratulations!

We have been informed that on March 3, Jack Benedict of Benedict-Miller Inc., Lyndhurst, New Jersey, was married to Miss Anne Lewis of Radnor, Pennsylvania in St. Martin's Church, Philadelphia, Pennsylvania. After a two-week honeymoon they will reside in Essex Fells, New Jersey.

New Agency

J. W. Rex Company of Lansdale, Pennsylvania, has named John T. Hall and Company of Philadelphia to handle Advertising and Public Relations. Mr. Jack H. Goodyear, vice-president of J. W. Rex Company, announced the appointment and said that it was effective January 1, 1956. The new agency replaces the Readinger Corporation, also of Philadelphia.

MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

HEATING EQUIPMENT SUGGESTIONS

The J. W. Rex Company, Lansdale, Pennsylvania, has announced the availability of an 8-page reprint of Mr. Rex's article which was published in METAL TREATING and is entitled "What the Commercial Heat Treating Industry Would Like to Have the Industrial Heating Equipment Manufacturers Develop".

This is the printed form of an address which Mr. Rex delivered at the Spring meeting of the Industrial Heating Equipment Association, Inc. last year.

For further information circle No. 11

SALT BATH CARBURIZING

The American Cyanamid Company, New York, N. Y., has announced the availability of an 8-page reprint of Mr. E. N. Case's article entitled "A Review of Salt Bath Carburizing" which was published in METAL TREATING.

It contains a good analysis of some of the outstanding advances that have been made in the field of liquid carburizing as a method of surface hardening.

For further information circle No. 12

METAL FINISHING SYSTEMS

Recently published is Despatch Oven's new 16-page color bulletin on metal finishing systems.

It is generously illustrated with photographs, drawings and diagrams. It contains suggestions on modern ways to achieve better finishes at lower cost, faster production and smoother handling of numerous products such as power tools, automobile frames and refrigerators.

Despatch refers to its bulletin "not as a catalog but as a functional representation of answers to your problems in metal finishing."

Discussion of "completely engineered" finishing systems is directed to the plant manager, the chief engineer and the maintenance engineer as well as the production engineer.

For further information circle No. 13

FABRICATOR'S HANDBOOK

Crucible Steel Company of America has recently published "The Fabricator's Handbook." This 162-page book is designed to aid the fabricator of stainless steel parts and products.

There are seven sections to the book dealing with forming operations, machining operations, etc., and Section 5 deals with the heat treating, pickling, and scale removal of stainless steels.

For further information circle No. 14

TOOL STEEL BULLETIN

Crucible Steel Company of America has announced the availability of a newly-revised 44-page book entitled "Tool Steels for the Non-Metallurgist." Written to present a practical understanding of tool steels without being overly technical, the text is confined to direct, familiar phrases. It is intended to familiarize the non-metallurgist with the six basic classifications of tool steels, enabling him to better handle the numerous grades within the general classifications.

Properties of the various types of tool steels are discussed and general recommendations are made as to which type of application is most suitable for each classification. The book points out that final choice of a tool steel should, of course, be determined by actual job experience.

In addition to a discussion of basic tool steel types, the book also discusses *heat treating technique*, and includes tables of pertinent information.

For further information circle No. 15

NICKEL PLATING

An illustrated 20-page instruction manual on bright nickel plating by the Nickel-Lume process is offered by Hanson-Van Winkle-Munning Co., Matawan, N. J.

Three techniques for electro-depositing are described: Type I, for use in still tanks or with conveyors where work loads are in mild motion; Type II, for use with air agitation; and the Barrel process for plating in cylinders.

The manual explains the proper bath preparations for these processes, the converting of existing baths to Nickel-Lume, and the effect of the important constituents. Solution maintenance, purification, handling of equipment and materials are discussed. Analytical procedures, for all of the constituents, including the addition agents, are outlined.

Plating of special equipment such as marine hardware, automobile bumper guards, surgical instruments (which can be sharpened after plating), electric irons, toasters and grills which must retain their bright finish after extreme temperature changes, is fully described and illustrated.

For further information circle No. 16

METAL TREATING

EQUIPMENT and MATERIALS DIRECTORY

AGITATORS

J. P. DEVINE MANUFACTURING CO.
49th Street and A. V. R. R.
Pittsburgh 1, Pennsylvania

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THE PRESSED STEEL COMPANY
Wilkes-Barre, Pennsylvania

ROLLED ALLOYS, INC.
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Detroit 7, Michigan

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THE A. F. HOLDEN CO.
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UNITED STATES STEEL CORP.
OIL WELL SUPPLY DIVISION
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METAL FINISHING

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Denver, Colorado

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Detroit 27, Mich.

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New York 17, New York

CLARK INSTRUMENT, INC.
10203 Ford Road
Dearborn, Michigan

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TOOL STEELS

BETHLEHEM STEEL COMPANY
Bethlehem, Pennsylvania

CRUCIBLE STEEL COMPANY OF AMERICA
Pittsburgh, Pa.

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